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AUTHOR Millar, Dan P.; Millar, Frank E.
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ABSTRACT

For years, researchers have sought to identify facial features and movements that make a difference to an observer when judging emotional displays. One area that has received attention is that of semantic dimensions of facial expressions. Factor analysis has revealed three such dimensions: pleasantness, activity (tension), and control (spontaneity). A study investigated whether the semantic dimensions of pancultural facial expressions configured differently--from one another and within each expression. Subjects were 312 college students who viewed seven slides of actors' faces displaying the emotions of anger, disgust, fear, happiness, sadness, and surprise. One slide depicted a neutral expression. As they viewed the slides, the subjects identified the emotion displayed and completed several semantic differential scales associated with the dimensions of pleasantness, activitiy, and control. ANOVA revealed differences between expressions on the dimensions and between dimensions for each of the expressions. The results support the need for researchers to study different faces and different populations before accepting the proposition that the pancultural expressions have different and stable semantic space configurations. (FL)

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ANALYSIS OF THE DIMENSIONS OF SEMANTIC SPACE OF NEUTRAL AND SIX PANCULTURAL FACIAL EXPRESSIONS

Dan P. Millar
Central Michigan University

Frank E. Millar
Cleveland State University

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Abstract

This study addressed three questions: Does the semantic space for pancultural facial expressions of emotion configure differently over three semantic dimensions? If so, which dimension has greatest impact upon the configuration? Will the differences remain if initial impressions of the face (score on a Neutral expression) are accounted for? Three-hundred and twelve Ss viewed 7 slides displaying Neutral, Anger, Disgust, Fear, Happiness, Sadness and Surprise completing 16 semantic differential scales associated with the semantic dimensions of Pleasantness, Activity, Control. ANOVA with Studentized Range Statistic revealed differences between expression on the dimensions and between dimensions for each of the expressions. Accounting for the initial judgment of the face on the Neutral expression did not change the differences between the 6 pancultural expressions nor the order to difference. The results identify the need to study different faces and different populations before accepting the proposition that the pancultural expressions have different and stable semantic space configurations.

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Dan P. Millar
Central Michigan University

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Cleveland State University

Modern studies of facial expression can be traced to the work of Charles Bell, Essay on the Anatomy and Philosophy of Expression: As Connected with the Fine Arts, written in 1806. This work influenced the more famous 19th century publication by Charles Darwin, The Expression of the Emotions in Man and Animals, which has, in turn, influenced 20th century researchers. Since the Darwin publication in 1872, three traditions for researching emotional expression have emerged from the empirical research of the mid-20th century.

The first tradition, closely connected to Bell and Darwin, seeks to identify the emotions displayed by the face as interpreted by the observer. Davitz (1964), Dittman (1972), Izard (1971) and Ekman and Friesen (1975) have conducted research in which the emotional identification was the dependent variable. Some of these studies have crossed cultures leading to the hypothesis that some facial expressions, and therefore emotions, may be considered "universal," pancultural. Ekman, Friesen and Ellsworth (1972) specifically identify six such expressions: anger, disgust, fear, happiness, sadness and surprise. Also consistent with this tradition is the work of Leathers (1980) and Rosenthal et.al. (1979). Each has created a measure of nonverbal sensitivity based upon the assumption that accuracy of emotion identification exemplifies awareness of, and sensitivity to, nonverbal cues.

The second tradition, closely aligned with the first, has sought to identify facial features and facial movements which made a difference to an observer when judging emotional displays. The early work of Birdwhistell (1952) attempted to identify and code facial kines. Harrison (1964) used pictic analysis to determine which facial cues -- brow , eye, mouth -- or combinations created meaning in the observer. The FAST of Ekman and Friesen (1971) uses the computer to generate different facial configurations seeking to determine which configurations stimulate differential meaning. Generally, this tradition specified the three areas of the face -- brow, eyes and eye region and mouth -- with the greatest movement potential as the source of emotional display and identification. Further, each area has been associated with particular facial expressions of emotion. For example, anger has been associated with the lower mouth and brows/forehead regions; disgust with the lower face/mouth; and fear with the eye region.

The third tradition also focuses upon the observer attempting to determine upon what semantic dimensions interpreters judge facial expression. Schlosberg (1954), Osgood (1966). Mordkoff (1967) and Williams (1965) have sought to specify the content of the semantic dimensions upon which observers base their decisions. Factor analysis has revealed two, and sometimes three, dimensions: pleasantness, activity (tension) and control (spontaneity). The first has been the most stable dimension, control the least stable dimension. The relative attractiveness of the face is measured by the pleasantness dimension, the action of the face is measured by activity, and the degree of intentionality, of spontaneousness is measured by the control dimension.

Although each tradition has generated considerable research independent of the other two, a question arises which connects the first (identification of emotion) with the third (dimensions of meaning): Does the semantic space of pancultural facial expressions differ for each expression? To thoroughly answer the question research would have to include a variety of emotions, a variety of faces, and a variety of populations. The intent of this study was to determine if the semantic space of different facial expressions of emotion configure differently -- from one another and within each expression?

Of secondary interest, assuming the facial expressions do configure differently, was to ascertain which of the three dimensions was the most important in differentiating the expressions? The pleasantness dimension appears the most stable. But does that suggest that the pleasant dimension scores would be the best indicators of differing expressions?

A third area of interest arises from research on initial impression and interpersonal attractiveness: What effect, if any, does the evaluation of the stimulus face when "neutral" (attempting to display no emotion) have upon the evaluation of the stimulus face along the three dimensions when the face is active?

The second and third areas of interest can be examined only if the faces do configure differently on the semantic dimensions of pleasantness, activity and control. The initial effort in this study was to determine if the semantic space associated with six pancultural expression and one neutral expression is significantly different.

METHOD

Slide Stimuli

Student actors auditioned to display facial emotions which would be used in the study. Twelve people auditioned. Two men and a woman were selected. All three of these people were asked to create situations which required displaying the emotions of anger, disgust, fear, happiness, sadness and surprise. During the photography sessions these situations were given to the actors and slides taken of their reactions. A group of five judges selected the slides from each actor which best displayed each of the emotions. Each actor also was asked to relax the face, to permit the features freedom from tension. Slides taken following these instructions were intended to be "neutral." The set of 7 emotions, the 6 pancultural expressions plus neutral, were pilot-tested to determine if observers could accurately identify the emotion intended by the actor. Accuracy for the seventy-one subjects was: anger 87% correct, disgust 77%, fear 90%, happiness 100%, sadness 83% and surprise 100%.

Subjects

Students enrolled in introductory communication theory courses at Central Michigan University (150 Ss) and Montana State University (164 Ss) became the subjects for the study. Of the 314 Ss, 2 failed to correctly complete the scales, leaving the analysis computed for 312 Ss. Of the subject pool, 161 were men, 151 were women.

Semantic Differential Scales

To the same group of 71 Ss who tested the emotions in the slides, 37 polarized adjectives, drawn from previous facial expression

research, were given for judging the emotions in the slides. Using the criteria for adjective-to-factor of .70, 16 bi-polar adjectives were selected to make-up the response scales. The 16 factored along the pleasant, activity, control dimensions with the following distribution: Pleasant -- pleasant-unpleasant, optimistic-pessimistic, beautiful-ugly, sociable-unsociable, agreeable-disagreeable, kind-cruel, sensitive-insensitive, interesting-boring, colorful-colorless; Activity -- active-passive, excitable-calm, emotional-unemotional; Control -- free-constrained, intentional-unintentional, loose-tight, relaxed-tense.

Procedures

The subjects were shown each stimulus slide. They identified the emotion and completed the 16 semantic differential scales before seeing the next slide. The slide order was random with neither researcher knowing the order used by the other. Prior to seeing the 6 emotional slides, the subjects were shown the neutral slide, told it was neutral and asked to complete the scales. Each slide was shown for 10 seconds with the screen blank for 90 seconds while the scales were completed and the emotion identified.

RESULTS

To determine whether or not the semantic space configured differently across the facial expression, dimension $\bar{X}$s were computed for the 7 expressions.[1] The dimensions $\bar{X}$s for each expression are displayed in Figure 1. The visual display suggests

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Insert Figure 1

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a difference between the dimensions. Notice (a) the highest scored dimension is Activity when the face displays emotion, (b) the greatest change in scoring occurs on the Pleasant dimension, and (c) the Control dimension follows the pattern of the Pleasant dimension.

Two steps were taken to determine if the visual differences between expressions and dimensions were statistically significant. First, the total dimension score (sum of the 16 scales for each face) was computed and compared by expression. Second, the dimensions scores were compared with each other. The ANOVA revealed the expressions to be different (SS = 4397.66, DF = 6, MS = 732.94, F = 547.18, p = .001). To determine the locus of the differences the Studentized Range Statistic (Winer 1971) was computed and the results are reported in Table 1.[2] The expressions

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Insert Table 1

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divide into two groups. The grouping of Disgust, Anger, Neutral and Sadness is not different among themselves but is different from the grouping of Fear, Surprise and Happiness. The latter three expressions are different from one another as well as from the grouping of four expressions.

The comparison between dimensions is reported in Table 2.

Insert Table 2

Each dimension appears different from the others. Activity is the most different from the other two dimensions. The visual

differences do appear to be statistically different when the faces and the dimensions are compared. As might be expected an interaction between expression and dimension was significant also (SS = 1784.05, DF = 12, MS = 148.62, F = 206.15, p = .001).

Given a difference between expressions and between dimensions, which dimension appears most important in the configuration of the semantic space? Again, two steps were taken to answer the question: determine if each dimension differs across expressions and then determine if the dimensions differ within expressions. For the Pleasant dimension an ANOVA reveals that differences exist (SS = 2668.39, DF = 6, MS = 444.73, F = 650.49, p = .001). Table 3

Insert Table 3

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displays the locus of the differences. Notice all expressions differ when compared except one combination -- Neutral and Fear. For the Activity dimension an ANOVA reveals that differences exist (SS = 1660.67, DF = 6, MS = 276.78, F = 274.05, p = .001). Table 4 displays the locus of the differences on this dimension. As with

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Insert Table 4

Pleasant dimension, the majority of comparisons are statistically different. The exceptions are Sadness and Disgust, Anger and Fear, Fear and Happiness. On the Control dimension an ANOVA reveals that differences exist (SS = 1352.64, DF = 6, MS = 308.77, F = 283.74, p = .001). Table 5 displays the locus of differences

on the Control dimension. All the comparisons are statistically

Insert Table 5

different except the combinations of Disgust and Fear, Sadness and Fear.

The second step requires the determination of differences between dimensions within each of the 7 expressions. For the Neutral expression, ANOVA reveals that differences exist between the three dimensions (SS = 57.76, DF = 2, MS = 26.38, F = 31.6, p = .001). All three dimension comparisons reported in Table 6

Insert Table 6

are different, with the Control dimension the most different. This is the only instance in which Control was the most highly scored of the three dimensions.

ANOVA for the expression of Anger revealed difference between dimensions (SS = 1637.83, DF = 2, MS = 818.92, F = 924.79, p = .001). No difference appears between Control and Pleasant. Differences

Insert Table 7

are reported in Table 7 between Control and Activity and Pleasant and Activity. Activity was the most highly scored of the three.

The expression of Disgust was found different for the three dimensions based upon ANOVA (SS = 810.54, DF = 2, MS = 405.27, F = 423.6, p = .001). Table 8 displays the location of the differ-

ences -- between Pleasant and Activity, Control and Activity.

Insert Table 8

Activity again appears as the most highly scored dimension.

The ANOVA for Surprise (SS = 279.20, DF = 2, MS = 139.60, F = 268.43, p = .001)reveals that differences exist between the dimensions. Table 9 shows all three dimensions are different from each other with Activity most highly scored.

Insert Table 9

For the expression of Sadness, ANOVA again suggests that differences exist between the dimensions (SS = 333.37, DF = 2, MS = 166.68, F = 199.53, p = .001). The differences are displayed

Insert Table 10

in Table 10. Activity is the most highly scored of the dimensions and is different from the other two dimensions. Control and Pleasant do not appear difference, a finding consistent with the visual display reported earlier.

Happiness appears different between dimensions (SS = 71.44, DF = 2, MS = 35.72, F = 55.52, p = .001). Table 11 reports

Insert Table 11

each dimension is different from the other two. Pleasant is the

most highly scored.

For Fear the ANOVA agains indicated differences existed between the dimensions (SS = 1066.26, DF = 2, MS = 533.13, F = 621.26, p = .001). Table 12 displays the dimensions difference each from the other. Activity again appears the most highly scored of the

Insert Table 12

dimensions. Across expressions and within expressions the dimensions were statistically different from one another.

Determination of the impact of the evaluation of the face at rest (Neutral) upon subsequent evaluations when the face was active was the third area of interest. The score for the Neutral face was subtracted from the scores of the active expressions.[3] Figure 2 displays the configuration of dimension $\bar{X}$s for the 6 pancultural facial expressions. Comparing Figure 2 with Figure 1 suggests the conclusion that Neutral has little impact upon subsequent evaluations. The visual displays show only two modest changes, for the expressions of Disgust and Happiness, in the patterns from Figure 1.

Insert Figure 2

The ANOVA suggests that differences exist between the expressions despite the subtraction of the Neutral score (SS = 3969.16, DF = 5, MS = 793.83, F = 614.55, p = .001). Differences were found also between the dimensions (SS = 5463.81, DF = 2, MS = 2731.90, F = 412.77, p = .001). And, as reported earlier, a significant inter-

action between expressions and dimensions (SS = 1003.50, DF = 10, MS = 100.35. F = 148.38, p = .001). Table 13 reports the locus

Insert Table 13

of the differences on the dimensions between expressions. Disgust, Anger and Sadness are not statistically different, a result similar to that reported earlier including the Neutral expression. Fear, Surprise, Happiness are different from one another and different from the grouping of expressions -- Disgust, Anger and Sadness.

Table 14 reports the differences between dimensions. Each

Insert Table 14

dimension differs from the others with Activity the most different from the other two.

DISCUSSION

The first question addressed in this study was whether or not the semantic space differed for six pancultural facial expressions. The data recommends a qualified "yes" to the question. When the dimensions were totalled for each expression Disgust, Anger, Sadness and Neutral were not different from one another. These four expressions were different from Fear, Surprise and Happiness which, in turn, were different from one another. For the four expressions which did not show a difference the dimensions of Pleasant and Control were closely aligned.

Analysis of each dimension revealed that the dimensions were configuring differently for the facial expressions. The Pleasant

dimension differed on all comparisons of expression except Neutral-Fear. The Activity dimension differed on 18 of 21 comparisons. The three comparisons not different were Sadness-Disgust, Anger-Fear, and Fear-Happiness. The Control dimension was different for all comparisons except Disgust-Fear and Fear-Sadness. Five of the 6 comparisons found not significantly different involved the expression Fear. Perhaps an explanation may be found in the regions of the face associated with the various pancultural expressions. Disgust, Anger, Sadness, Surprise and Happiness have been associated with the most mobile portions of the face -- brow-forehead and mouth/mouth region (Ekman and Friesen, 1975) -- or a combination of those two regions. Fear, on the other hand, is most associated with the eyes and eye region, the facial region least able to make large, gross movements.

Despite the few non-significant comparisons, the semantic space of the pancultural facial expressions apears to configure differently. The interaction effect between expression and dimension also supports the qualified "yes" to the first question addressed.

The second question sought to determine which dimension most influenced the configuration of the semantic space. Activity appears to be the influential dimension. First, it is consistently the most highly scored dimension. Second, Activity has a unique pattern while Pleasnt and Control follow similar patterns across facial expressions. The alignment of Pleasant and Control is somewhat surprising. The adjective quality of the dimension would make connection with Activity more appropriate. Two explanations seem plausible. First, consistent with previous studies which

found Control (Spontaneity) appearing only inconsistently, the dimension may not be an independent dimension. Or, constraining, tightening, tensing the face may alter an observers impression of the attractiveness of the face. The latter explanation seems more plausible since tightening, tensing, constraining can lead to facial feature movement and movement is evaluated on the Activity dimension. So, tightening leads to activity but the activity itself may contort the face into unattractiveness. Interesting that the only occasion in which Control was the highest ranked dimension was for the expression Neutral. Control scored higher than Neutral for the expressions Surprise and Happiness suggesting a relxation of facial control and an increase in Spontaneity. But Neutral was the only expression in which Control ranked higher than Pleasant and Activity.

Finally, the general impression of the face appears not to influence semantic assessment of subsequent expressions, the third question addressed in the study. The finding counters "common sense" experience which finds faces initially assess as attractive or mobile. Attractive faces may, when contorted in the extreme expressions of emotion, have greater impact upon an observer because of the distort. In similar manner, the unattractive person may be less able to display the pleasant emotions because of the facial features. What caused the result in this study is unclear -- the sequence of the subsequent expressions? the general attractiveness of young faces? some residue of the research procedure? Future studies altering faces and sequences will be needed before the result becomes clear.

CONCLUSION

The face has generated considerable research over the past 100 years. Recently, researchers have argued that some (6 - 8) faces may be "pure" and are recognizable across cultures. All other expressions are blends. If this assertion is true then the semantic space within which these faces are evaluated may have a consistent and different configuration. This study sought to begin an examination of the connection between pancultural expressions and semantic space. Obviously, to make a significant statement, the connection needs to be researched with other faces, and other populations. However, on the bases of the data analyzed in this study, the possibility that consistent semantic space configuration exists remains a reasonable assumption.

FOOTNOTES

[1]The accuracy of emotional identification by the Ss was (the number correct per Ss): 0 - 1, 1 - 11, 2 - 17, 3 - 37, 4 - 78, 5 - 6, 6 - 164.

[2]The Studentized Range Statistic using Newman-Kruels procedure was used for all analysis once ANOVA uncovered the existence of differences.

[3]A cross-check on the procedure of subtracting the Neutral was completed by computing an analysis of covariance with Neutral the covariant. COANOVA revealed significances between expressions (SS = 3969.15, DF = 5, MS = 793.83, F = 614.55, p = .001) and between dimensions (SS = 2865.37, DF = 2, MS = 1432.68, F = 1089.06, p = .001). The interaction effect also was present between expression and dimension (SS = 1003.50, DF = 10, MS = 100.35, F = 148.38, p = .001). Because the COANOVA and the visual display appeared consistent with the pattern of results described earlier, no additional analysis was computed.

Figure 1

Dimension $\bar{X}s$ by Facial Expression

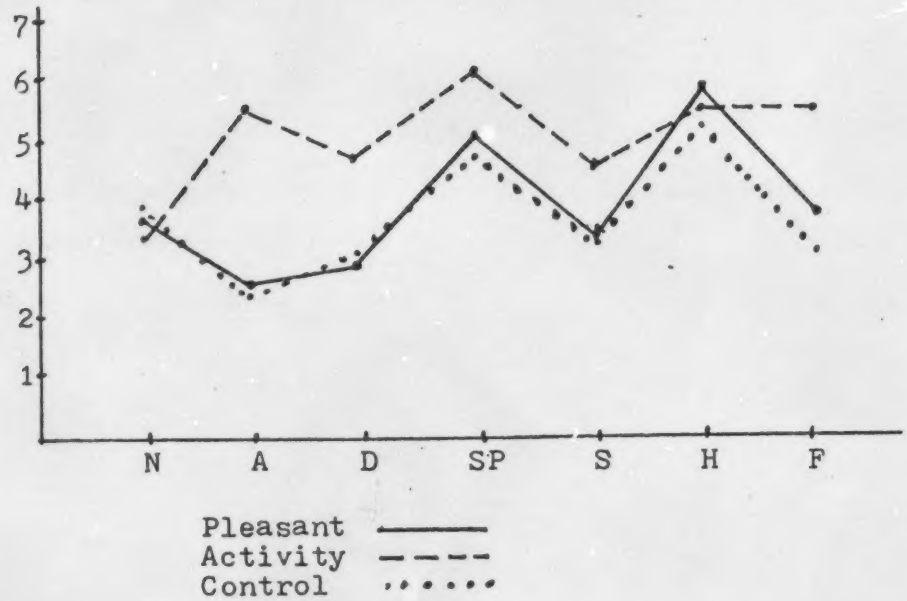

Table 1

Dimension $\bar{X}$ Average by Facial Expression

	D 3.63	A 3.65	N 3.66	S 3.78	F 4.21	SP 5.39	H 5.70
D 3.63	----	.02	.03	.15	.58*	1.76*	2.07*
A 3.65		----	.01	.13	.56*	1.74*	2.05*
N 3.66			----	.12	.55*	1.73*	2.04*
S 3.78				----	.43*	1.61*	1.92*
F 4.21					----	1.18*	1.49*
SP5.39						----	.31*
H 5.70							----

*p = .05

Table 2

$\bar{X}$ Difference Between Dimensions

		Control	Pleasant	Activity
Control	3.75	---	.22*	1.40*
Pleasant	3.97		---	1.18*
Activity	5.15			---

*p = .05

Table 3

$\bar{X}$ Differences Between Expressions: Pleasant Dimension

		A 2.77	D 2.93	S 3.36	N 3.70	F 3.82	SP 5.21	H 5.98
A	2.77	---	.16*	.59*	.93*	1.05*	2.44*	3.21*
D	2.93		---	.43*	.77*	.89*	2.28*	3.05*
S	3.36			---	.34*	.46*	1.85*	2.62*
N	3.70				---	.12	1.51*	2.28*
F	3.82					---	1.39*	2.16*
SP	5.21						---	.77*
H	5.98							---

*p = .05

Table 4

$\bar{X}$ Differences Between Expressions: Activity Dimension

	N 3.36	S 4.62	D 4.94	A 5.52	F 5.67	H 5.79	SP 6.13
N 3.36	---	1.26*	1.58*	2.16*	2.31*	2.43*	2.77*
S 4.62		---	.03	.90*	1.05*	1.17*	1.51*
D 4.94			---	.58*	.73*	.85*	1.19*
A 5.52				---	.15	.27*	.61*
F 5.67					---	.12	.46*
H 5.79						---	.34*
SP 6.13							---

*p = .05

Table 5

$\bar{X}$ Differences Between Expressions: Control Dimension

	A 2.65	D 3.02	F 3.15	S 3.35	N 3.93	SP 4.83	H 5.32
A 2.65	---	.37*	.50*	.70*	1.28*	2.18*	2.67*
D 3.02		---	.13	.33*	.91*	1.81*	2.30*
F 3.15			---	.20	.78*	1.68*	2.17*
S 3.35				---	.58*	1.48*	1.97*
N 3.93					---	.90*	1.39*
SP 4.83						---	.49*
H 5.32							---

*p = .05

Table 6

$\bar{X}$ Differences Between Dimensions: Neutral

	Activity 3.36	Pleasant 3.70	Control 3.93
Activity 3.36	---	.34*	.57*
Pleasant 3.70		---	.23*
Control 3.93			---

*p = .05

Table 7

$\bar{X}$ Differences Between Dimensions: Anger

	Control 2.65	Pleasant 2.77	Activity 5.52
Control 2.65	---	.12	2.87*
Pleasant 2.77		---	2.75*
Activity 5.52			---
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*p = .05

Table 8

$\bar{X}$ Differences Between Dimensions: Disgust

	Pleasant 2.93	Control 3.02	Activity 4.94
Pleasant 2.93	---	.09	2.01*
Control 3.02		---	1.92*
Activity 4.94			---

*p = .05

Table 9

$\bar{X}$ Differences Between Dimensions: Surprise

	Control 4.83	Pleasant 5.21	Activity 6.13
Control 4.83	---	.38*	1.30*
Pleasant 5.21		---	.92*
Activity 6.13			---

*p = .05

Table 10

$\bar{X}$ Differences Between Dimensions: Sadness

	Control 3.35	Pleasant 3.36	Activity 4.62
Control 3.35	---	.01	1.27*
Pleasant 3.36		---	1.26*
Activity 4.62			---

*p = .05

Table 11

$\bar{X}$ Differences Between Dimensions: Happiness

	Control 5.32	Activity 5.79	Pleasant 5.98
Control 5.32	---	.47*	.66*
Activity 5.79		---	.19*
Pleasant 5.98			---

*p = .05

Table 12

$\bar{X}$ Differences Between Dimensions: Fear

	Control 3.15	Pleasant 3.82	Activity 5.66
Control 3.15	---	.67*	2.51*
Pleasant 3.82		---	1.84*
Activity 5.66			---

*p = .05

Figure 2

(Dimension $\bar{X}$s — Neutral) by Facial Expression

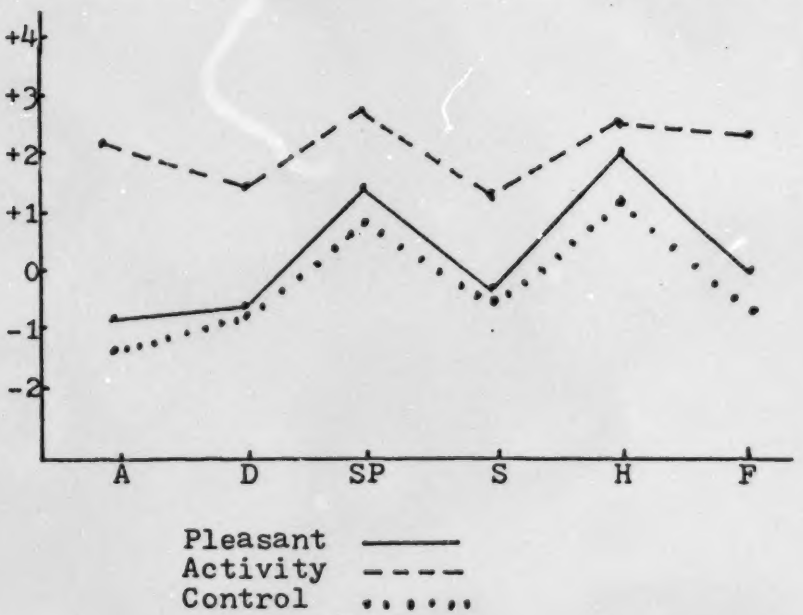

Table 13

(Dimensions $\bar{X}$ Average — Neutral) by Facial Expression

	D -.034	A -.017	S .116	F .547	SP 1.725	H 2.033
D -.034	---	.017	.150	.581*	1.759*	2.067*
A -.017		---	.133	.564*	1.742*	2.050*
S .116			---	.431*	1.609*	1.917*
F .547				---	1.178*	1.486*
SP1.725					---	.308*
H 2.033						---

*p = .05

Table 14

$\bar{X}$ — Neutral Difference Between Dimensions

	Control -.210	Pleasant .309	Activity 2.085
Control -.210	---	.519*	2.295*
Pleasant .309		---	1.776*
Activity 2.085			---

*p = .05

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